Prevalence and future prediction of type 2 diabetes mellitus in the Kingdom of Saudi Arabia: A systematic review of published studies

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Abstract

To highlight the prevalence and future projections of type 2 diabetes mellitus in the Kingdom of Saudi Arabia.

The systematic analytic study was conducted in the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia, from Dec 2014 to April 2015. Systematic bibliographic search of scientific databases including ISI-web of science, PubMed and Google Scholar was conducted with key words of "diabetes mellitus" "prevalence", "incidence". Total 46 peer reviewed papers were selected and examined. All the experimental and epidemiologic studies reporting the prevalence of diabetes in Saudi Arabia were included. There was no restriction on publication prestige and language of the publication. Finally, we included 21 publications and remaining 25 papers were excluded. The future predicted prevalence of type 2 diabetes was calculated on the results of the published studies by regressing the 33 years (1982-2015) of prevalence rate of diabetes against the time period.

The prevalence of type 2 diabetes in Saudi Arabia is 32.8%. However, the predicted prevalence will be 35.37% in 2020; 40.37% in 2025 and 45.36% in the year 2030. The coefficient on time factor indicated that prevalence rate has increased during 1982-2015.

Saudi Arabia has a highest prevalence (32.8%) of type 2 diabetes mellitus. We forecast that the incidence of type 2 diabetes will increase from 32.8% in 2015 to 45.36% in 2030. Saudi Arabia should include diabetes preventive measures on a war footing basis in their national health policy to minimize the burden of the disease.

Keywords: Diabetes Mellitus, Prevalence, Future projection, Saudi Arabia.
mellitus”, “hyperglycaemia”, “prevalence”, “incidence”, “occurrence”, “epidemiology” etc. Basic keywords were also entered in the Google Scholar search engine and after getting a related article, the title of that article was re-entered in the ISI-Web of Science and Pub-Med.

The article title and abstracts were thoroughly evaluated to consider the eligibility for inclusion. Studies in which diabetes mellitus, hyperglycaemia, prevalence, incidence, epidemiology were discussed were considered eligible for inclusion. No limitations on publication prestige, study design or language of publication were obligatory. However, we did not include secondary reports without the synthesis of novel data such as brief communications and non-observational correspondence. The inclusion criteria required that the study population must be of Saudi Arabia. All the studies were re-checked against pre-determined inclusion and exclusion criteria. We reviewed 46 papers, finally we included 21 studies and remaining 25 studies were excluded from the study. For the calculation of prevalence of type 2 diabetes in Saudi Arabia, we entered the prevalence of diabetes based on the results of the published studies. Predicted prevalence of type 2 diabetes mellitus was determined by regressing the 33 years (1982-2015) of prevalence rates of diabetes against the time period. In all cases, the coefficient on time was positive, indicating that prevalence rates increased during the period 1982-2015. We plotted a scatter chart and derived “Y” and “X” values based on the prevalence of diabetes. Y- indicated the prevalence in percentage, where X shows the year of prevalence. Future projection was calculated based on the equation

\[ \text{Future Projection} = (Y \times \text{value of year}) - X \].

**Ethics statement:** In this study we reviewed and analyzed the database literature on the occurrence of type 2 diabetes mellitus; hence, we did not require the ethical approval.

**Data analysis:** The extracted data for prevalence of type 2 diabetes mellitus was entered into the computer, programme SPSS Version 20 was used for analysis and the prevalence rate was reported descriptively.

**Results**

Table shows the prevalence of type 2 diabetes mellitus in the Kingdom of Saudi Arabia. Saudi Arabia has 32.8% prevalence of type 2 diabetes mellitus. It was 2.5% in the year 1982, 4.3% in 1987, 6.0% in 1990, 10.3% in 1997, 8.3% in 2000, 23% in 2004, 31.3% in 2011 and 32.8% in the year 2015. However, the predicted prevalence of type 2 diabetes mellitus in the Kingdom of Saudi Arabia will be 35.378% in 2020, 40.37% in 2025 and 45.36% in the year 2030. The coefficient on time

![Figure: Prevalence of type 2 diabetes mellitus in the Kingdom of Saudi Arabia.](image)

<table>
<thead>
<tr>
<th>Country</th>
<th>Author / year of publication</th>
<th>Urban / Rural</th>
<th>Sample size</th>
<th>Age range (Years)</th>
<th>Method</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>Bachus et al., 1982</td>
<td>Rural</td>
<td>1385 M</td>
<td>24-65 years</td>
<td>GTT</td>
<td>2.5%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Fataniet al., 1987</td>
<td>Rural</td>
<td>5222 M/F</td>
<td>&gt;30 years</td>
<td>RBG/OGTT</td>
<td>4.3%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Anukote 1990</td>
<td>Urban</td>
<td>3158 M/F</td>
<td>18-65 years</td>
<td>Urine/FBG</td>
<td>6%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>El-Hazmi et al., 1996</td>
<td>Urban / Rural</td>
<td>23493 M/F</td>
<td>2-70 years</td>
<td>OGTT</td>
<td>5%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Al-Nuaimi et al., 1997</td>
<td>Urban / Rural</td>
<td>13177 M/F</td>
<td>15-60 years</td>
<td>RBG/OGTT</td>
<td>10.3%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Warsy et al., 1999</td>
<td>Urban / Rural</td>
<td>14660 M/F</td>
<td>14-70 years</td>
<td>OGTT</td>
<td>8.3%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Karim et al., 2000</td>
<td>Urban / Rural</td>
<td>3747 M/F</td>
<td>&gt;35 years</td>
<td>RBG/OGTT</td>
<td>14%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Al-Nozha et al., 2004</td>
<td>Urban / Rural</td>
<td>16817 M/F</td>
<td>30-70 years</td>
<td>FBG</td>
<td>23.7%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Al-Baghi et al., 2010</td>
<td>Urban / Rural</td>
<td>197,681 M/F</td>
<td>&gt;30 years</td>
<td>FBG</td>
<td>18.2%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Al-Ree et al., 2011</td>
<td>Urban / Rural</td>
<td>6024 M/F</td>
<td>55.3 years</td>
<td>Self reported</td>
<td>30%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Al-Daghi et al., 2011</td>
<td>Urban / Rural</td>
<td>9149 M/F</td>
<td>7-80 years</td>
<td>FBG</td>
<td>31.6%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Al-Rubea et al., 2014</td>
<td>Urban / Rural</td>
<td>53370 M/F</td>
<td>30-765 years</td>
<td>FBG</td>
<td>32.8%</td>
</tr>
<tr>
<td>Total Mean%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.55%</td>
</tr>
</tbody>
</table>

DM=Diabetes Mellitus; U/R=Urban /Rural; M=Male; F=Females; FBG=Fasting blood sugar, OGTT=Oral Glucose Tolerance Test; Reference has been mentioned against each study.
factor was indicating that prevalence rates were increasing during the period 1982-2015. In Saudi Arabia the prevalence of diabetes increased in a step ladder pattern (Table, Figure).

Discussion
In the Arab world, Saudi Arabia is the Arab originated, third largest country constituting the bulk of the Arabian Peninsula. It has an estimated population of 30.77 million.\(^5\) A few studies have been conducted in Saudi Arabia to determine the prevalence of diabetes mellitus;\(^10\) Fatani et al., 1987;\(^11\) Anokute 1990;\(^12\) El-Hazmi et al., 1996;\(^13\) Al-Nuaim 1997;\(^14\) Warsy et al., 1999;\(^15\) Karim et al., 2000;\(^16\) Al-Nozha et al., 2004;\(^17\) Al-Baghl et al., 2010;\(^18\) Alqrashi et al. 2011;\(^19\) Daghi et al., 2011,\(^8\) Rubeaan et al., 2015\(^20,21\) (Table, Figure). In the present study, we reviewed the ISI web of science and PubMed based literature published between the period from 1982-2015 and found that the prevalence of diabetes mellitus is greatly increased in the Kingdom of Saudi Arabia [Table, Figure]. Presently, Saudi Arabia has prevalence of 32.8% of type 2 diabetes mellitus.

Bacchus et al., 1982\(^10\) conducted a study on the incidence of diabetes mellitus in 1385 males in the Al-Kharj region of Saudi Arabia by using WHO criteria for screening and interpretation of glucose tolerance tests. The age group of diabetic patients was 24-65 years and the overall prevalence was 2.8%. Bacchus et al.,\(^10\) study had some limitations including small sample size and representing male rural population only. Similarly, Fatani et al., 1987 reported the occurrence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%. Later, El-Hazmi et al.,\(^13\) (1996) reported the incidence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%. Later, El-Hazmi et al.,\(^13\) (1996) reported the incidence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%. Later, El-Hazmi et al.,\(^13\) (1996) reported the incidence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%. Later, El-Hazmi et al.,\(^13\) (1996) reported the incidence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%. Later, El-Hazmi et al.,\(^13\) (1996) reported the incidence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%. Later, El-Hazmi et al.,\(^13\) (1996) reported the incidence of diabetes mellitus from Saudi Arabia; the study also had similar limitations as Bacchus et al., including small sample size, representation of rural population, however, it showed the rising rate of diabetes and reported a prevalence of 4.3%. Anokute in 1990\(^12\) conducted a study, but shared the same flaws comparatively small sample size, not representative of the whole population as well as both gender and based on the university students and staff from an urban population. This study also confirmed the rising pattern of diabetes prevalence as 6%.
sample size studies which followed either ADA or WHO criteria, but we faced some methodological challenges; and in each study different methods were used to assess the glycaemic status. Due to the heterogeneity in the available literature, we were unable to select the uniform types of studies. Moreover, the literature is lacking therefore, we selected both randomized, cohort, and cross sectional, community and hospital based studies which followed either ADA or WHO criteria to confirm diabetes among the subjects.

Conclusion and Suggestions
The current prevalence of type 2 diabetes in the Kingdom of Saudi Arabia is 32.8%. The predicted prevalence will be 35.37% in 2020; 40.8% in 2025 and 45.8% in the year 2030. These figures show that diabetes mellitus is rapidly increasing in the Kingdom of Saudi Arabia. The projection of type 2 diabetes in the Saudi Arabia indicates that the situation may be more alarming than previously believed. The rising pattern of occurrence of type 2 diabetes mellitus develops a threatening and most challenging situation to the health care providers. It is suggested that, Saudi Arabia should include the diabetes preventive measures on a war footing basis in their national health policy to minimize the burden of the disease. Public education, regular physical exercise, nutritional knowledge of foods must be given to the community to control diabetes in the country. Diabetes and its complications should be frequently discussed in scientific, academic assemblies and both in electronic and print media to improve the public awareness to minimize the prevalence of the disease.

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References